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VISUAL AND TACTUO-MUSCULAR ESTIMATION OF LENGTH.

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These experiments were undertaken to determine the comparative accuracy of the senses of sight and touch aided by the muscular sense, in estimating unknown lengths.

The tests were made upon sixteen young men, students in the Stevens Point Normal School, ranging in age from 16 to 36 years.

The plan of the investigation included visual and tactuo-muscular estimation of length, (1) when each piece varied from the preceding one by half an inch, the other dimensions remaining the same for each series, though all dimensions varied with the different series; and (2) when the length and other dimensions varied irregularly.

Thirty-five pieces of planed wood were the objects judged.

The tactual series were taken first. The subject was seated in a chair and blindfolded, before the pieces which he was to estimate were brought into the laboratory. Each piece was handed to him in the order of gradually increasing length, as indicated in the figures at the top of each chart. He was allowed as much time for his decision as he desired.

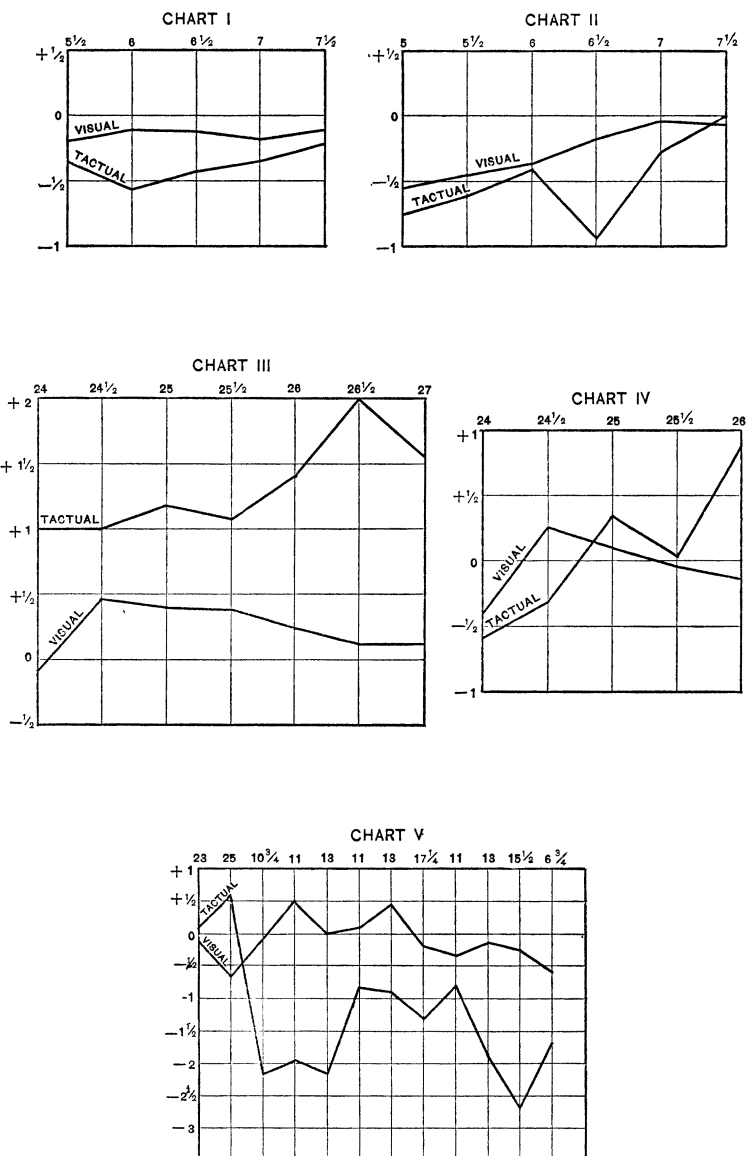
The visual series immediately followed the tactuo-muscular. The subject stood in front of a bench on which the pieces were laid, one at a time, in the same order as before. He was allowed to look at each piece so long as he desired before deciding, but could not touch them.

Chart I represents graphically the first series. The line of no error is marked 0, and the other figures at the left, above and below 0 indicate the amount of over and under estimation, according as they are plus or minus. One square represents a variation of $\frac{1}{2}$ inch.

The figures at the top of the charts give the real length of the pieces under examination. The width of these pieces was $4\frac{7}{8}$ inches and the thickness $\frac{3}{8}$ of an inch.

The greatest average visual error is seen to be an underestimation of about 1.5 of an inch and the last a little less than $\frac{1}{8}$ of an inch. The line is remarkably regular.

The tactuo-muscular error, an underestimation as before, is always greater.



The width of the pieces estimated in Chart II was $2\frac{1}{8}$ inches and the thickness $\frac{3}{4}$ of an inch.

The least visual error is $-\frac{1}{16}$ and the greatest is $-\frac{9}{16}$ of an inch. The least tactuo-muscular error is 0 and the greatest is $-\frac{15}{16}$ of an inch. The visual line, beginning with quite an error, steadily approaches the line of no error. The tactual line is more erratic.

The length represented in Chart III differed greatly from the preceding as shown at the top of the chart. Their width was $3\frac{3}{8}$ inches and their thickness $\frac{3}{4}$ of an inch.

The lines show an overestimation in both cases, the tactuo-muscular greatly exceeding the visual. The greatest visual error is not quite $\frac{1}{2}$ inch while the greatest tactuo-muscular is 2 inches.

The pieces estimated in Chart IV were $1\frac{1}{2}$ inches wide and $\frac{3}{8}$ of an inch thick.

Both lines are quite irregular. The visual begins with its greatest variation, an underestimation of $\frac{3}{8}$ of an inch, and jumps at once to an overestimation of $\frac{1}{4}$ inch. As in all other series the tactuo-muscular error is the greater.

In the preceding estimates the pieces increased in length regularly by one-half inch. In order to learn to what extent this regularity aided the subjects in coming to their decision another test was made with pieces that varied irregularly in all dimensions. The result is given in Chart V.

It will be noticed that while the visual line is more irregular than when the pieces varied regularly, still the greatest error is only a little more than the greatest visual error in Chart II. The tactuo-muscular line shows great variation and great irregularity.

A comparison of the charts shows :

1. That the sense of sight is much more accurate in estimating length than the sense of touch aided by the muscular sense.

2. In judging short pieces, the tendency is to under-estimate both by sight and touch.

3. The visual memory, at least for a short time, is more accurate than the tactuo-muscular. The subjects were able to carry the lengths gotten through the sense of sight better, as shown by the fact that their following estimates were more consistent with the former.

4. The sight judgments are quite regular while the tactuo-muscular make frequent jumps, as though the subject had lost track of his preceding standards of length.